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Knowledge Brokerage for Environmentally Sustainable Sanitation

Edited by Wiebe E. Bijker, Giovanni Caiati
and Luciano d'Andrea



Position Paper and Guidelines from the EU-FP7 BESSE project



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July 2012



Colophon

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- Water Engineering Development Centre (WEDC), University of Loughborough, Loughborough, UK
- Research Centre Regional and Global Development (REGLO), Sofia, Bulgaria
- The Municipality of Castel Sant'Angelo di Rieti (CSA), Castel Sant'Angelo di Rieti, Italy
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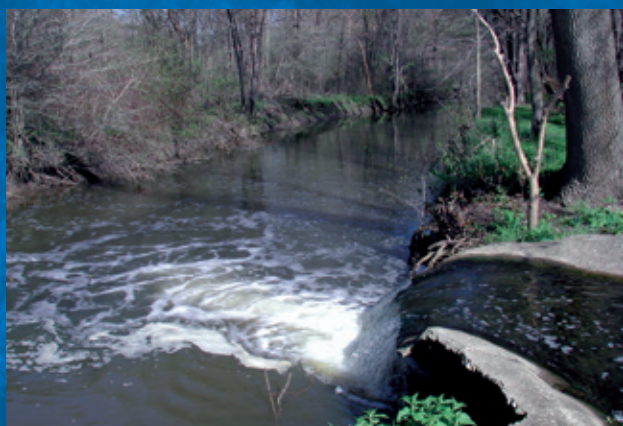


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1 Introduction

Knowledge brokerage is the activity and the process to facilitate knowledge and technology to move from one place to another, in order to help individuals and organisations learn, innovate and improve. This report summarises the main findings pertaining to knowledge brokerage in the EU-FP7 project BESSE (Brokering Environmentally Sustainable Sanitation for Europe).

BESSE's testing ground to experiment with knowledge brokerage was *environmentally sustainable sanitation (ESS)* and the question it set out to answer was 'how to facilitate innovation in the sanitation sector to make it more sustainable'. BESSE also studied different innovations in environmentally sustainable sanitation; these are reported on in the resource file on the BESSE website (see below).

This report presents the highlights from our BESSE project on these two lines of work, namely knowledge brokerage and sustainable sanitation. It does so by being a combination of a position paper (chapters 2-5) and policy guidelines (chapter 6). As a position paper it takes stock of work done in Europe on sustainable sanitation, and on experiences with knowledge brokerage. As policy guidelines it advises on how knowledge brokerage can be shaped and enhanced, especially to encourage innovation to facilitate sustainable sanitation.

Although focused on sanitation and sanitation-specific problems related to knowledge transfer, most of the project outputs have a broader relevance since they touch on issues which emerge when environmental policies are concerned. Moreover, BESSE's experience may also have relevance with respect to how knowledge dynamics - linking research, industry, policy making and society - are changing in Europe. This should be particularly relevant for the European research policies that, through the shift from the 7th Framework Programme to Horizon 2020, is now seeking to intensify such relationships in order to boost research and innovation.

The BESSE project was carried out in several work packages, ranging from mapping novel sanitation technologies, to experimenting with knowledge brokerage. The results of all these work packages are available as a resource on the BESSE website: <http://www.besse-project.info/>. This report will act as a guide to these work package reports in the resource files by providing the main highlights and key lessons learned. At the same time, it has been conceived as an autonomous publication with the aim of helping use knowledge brokerage to support innovation in the sanitation sector.

Three wastewater treatment organisations - in Bulgaria, Italy and The Netherlands - provided the empirical research sites for BESSE. These companies (and the public authorities that are responsible for their management) collaborated with research and

public policy institutions to experiment with and reflect on innovative processes and the possible role of knowledge brokerage therein; see the *colophon* for a full list of the members in the BESSE consortium.

An important part of the BESSE work was our own learning process to better understand knowledge brokerage, sustainability, and innovation in wastewater treatment, and how to do so in this hybrid combination of sanitation companies, research institutes, and public policy agencies. In that sense, BESSE has been one over-arching knowledge brokerage project from beginning to end. The next chapter will highlight this aspect, and further introduce details of the BESSE project.

This report is organised in six chapters, including this introduction. Chapter 2 introduces details of the project as a learning process, describing the key questions dealt with (namely, sustainability in sanitation and knowledge brokerage) and its overall outcomes. Chapter 3 describes the empirical basis of the project, while Chapter 4 provides a picture of the innovation dynamics in sanitation, drawing out a new understanding of the role of knowledge brokerage in the sector. In Chapter 5, the key lessons emerging from BESSE on the application of knowledge brokerage are presented. Finally, Chapter 6 presents a set of recommendations for shaping knowledge brokerage policies to support environmentally sustainable sanitation in Europe.



2 The BESSE project as a learning process

An important part of the BESSE work was the learning process that the ten BESSE partners jointly engaged in. Wastewater treatment engineers quizzed the researchers about their abstract notions of knowledge brokerage; policy experts pushed the more general applicability of local practices; and academics queried what exactly sustainability could mean in a sanitation context. BESSE has been an extensive knowledge brokerage project from beginning to end, in which each and every partner alternately was knowledge broker to facilitate learning between other BESSE partners, or benefited in her/his own learning from the BESSE interactions.

One key lesson about knowledge brokerage is to recognise it when it is happening, and then to value it and to enhance it. That is what we will highlight in this chapter: the learning process that the BESSE project itself was. And, not surprisingly, this learning was about what precisely do we mean by ‘environmentally sustainable sanitation’, what ‘knowledge brokerage’ meant for all of us, and about the very aims and set-up of the BESSE project itself.

2.1. Environmentally sustainable sanitation: principles and orientations

Environmentally sustainable sanitation (ESS) is an emerging paradigm for managing wastewater and excreta in a more sustainable way, in terms of environment and resource protection, health and hygiene, economic and financial viability and social acceptance.

ESS is based upon a critical analysis of the conventional, centralised sewage systems from the points of view of both environmental sustainability and economic effectiveness. Conventional systems are based on costly pipeline networks. These networks deal with the following challenging characteristics:

- the use of water for transporting waste implies a diversion of scarce clean water from other more effective and basic uses (drinking, cooking, bathing);
- most large networks in Europe are in an advanced state of decay, resulting in increased sewage leakage into water supplies and groundwater (with ever-higher risks for public health) or, alternatively, almost unmanageable maintenance costs (with high financial implications for municipalities);
- water treatment processes aiming at extracting clean water from sewage are very costly and hardly effective;
- the proper management of sludge remains an unsolved problem since – depending on the strategy adopted – it produces risks of seawater or groundwater pollution, air pollution or soil contamination.

It is also necessary to take into account that using sewage networks for rainwater

drainage, as per the norm, is particularly dangerous for health in the case of severe rainfall causing the release of untreated sewage into the environment.

ESS philosophy, principles and techniques are very different from conventional sanitation approaches. ESS primarily promotes a decentralised approach, according to which sanitation problems should be solved at local level – in the household, neighbourhood or community. This would avoid risky and costly transportation of waste from houses to treatment plants and would result in a drastic reduction or even elimination of the use of water as a transportation method. Decentralisation implies the development of locally compatible solutions, which necessarily entail participation of all the stakeholders in the decision-making process. Moreover, ESS considers the separation of faecal matter and urine crucially important, since this is much safer and cheaper than the extraction of water and sludge from sewage in the current treatment plants. Reuse of water is another key point for ESS, made possible by a differentiated treatment of grey water (i.e. all household water except toilet waste), at local level.

ESS principles and approaches favour the development of a wide range of new technologies and techniques in the collection, treatment and utilisation of faeces, urine, grey water and rainwater. It is remarkable to note that such ESS principles, approaches and technologies are taking off much more swiftly in less-developed and transitional countries (where conventional sewage networks are less developed) than in Europe (where such networks are fully developed). In Europe, ESS diffusion is hindered by different factors including economic interests, cultural resistances, professional barriers, regulatory systems, institutional settings and organisational procedures.

As we will argue below (see chapter 3), such hindering factors emerge not only when ESS-inspired innovative solutions are proposed, but also when less impacting innovations are concerned. This is the reason why BESSE did not only focus on ESS experiences and technologies, but broadened its scope to encompass questions, obstacles and processes connected with innovation in sanitation as a whole, viewing the building of an enabling environment for innovation as a necessary step towards a shift from conventional to more sustainable approaches to sanitation.

2.2. Environmentally sustainable sanitation: what is at stake?

Environmentally sustainable sanitation is sanitation that minimises the environmental impact of its processes. This minimising can, for example, be realised by a reduction in energy usage or in the pollution levels connected to the management of organic waste. The key terms in the central aim of BESSE are:

Sanitation: the treatment of collected wastewater by mechanical, chemical and biological means.

Sustainable: viable on a very long-term (according to a broad range of variables: environmental, financial, cultural, political and social)

Environmental: pertaining to the impact on the biological and ecological environment.

What is at stake? Clean water is essential for humans, livestock, nature, and indeed for all aspects of human life. It is so essential, that it is typically provided by the state (often at municipal or regional level) as a basic infrastructure. This has resulted in a paradoxical situation: waste sanitation is so crucial and omni-present, that sanitation is hardly visible in current European societies. This was different in Europe before the 20th century. Thus the hygienists identified the issue of clean water as a crucial element for public health. This not only spurred the emergence of the modern medical profession, but also led to the construction of sewage systems and wastewater treatment plants.

Sanitation is invisible: not only physically invisible in the landscape (since most plants are remotely located and nicely camouflaged) but also hardly financially visible in citizens' budgets. This results in a lack of awareness amongst most citizens and many politicians and policymakers of the need to improve all aspects of sanitation provision. The EU should be complimented for identifying the need to improve the environmental sustainability of sanitation (see, for example, the Environment Work Programme 2008, ENV.2008.4.2.3.2, 'Enhancing connectivity between research and policy making in sustainable development' and the objectives of Europe 2020 with the Flagship Initiatives 'Innovation Union' and 'A Resource Efficient Europe').

BESSE increased the awareness about the weight of two key elements related to innovation in sanitation. On the one hand, innovation not only relates to technology but also to finances; and on the other hand, it not only calls for knowledge brokerage between universities and sanitation companies, but also for brokerage between sanitation engineers, policymakers and citizens. The identification of environmentally sustainable sanitation as a key policy goal for Europe and its member countries thus leads to a broadening of the issue: sustainability is not only about the environment, it is also about energy usage, technical maintenance, finances and political support. This will be documented further in later chapters in this report.

2.3. Knowledge brokerage: a preliminary conceptualisation

Knowledge brokerage is the activity and the process to facilitate knowledge and technology to move from one place to another, in order to help individuals and organisations to learn, innovate and improve. The key terms in this second aim of BESSE are:

Knowledge: includes scientific and engineering knowledge, as well as users' knowledge, and (ideas for) technological innovation.

Brokerage: is the intermediating (or ‘boundary’) work between places (or individuals or organisations) with more knowledge and less knowledge.

The BESSE project started from the diagnosis that there is a gap between the practice of sanitation and the available knowledge and technologies. Most sanitation plants in Europe are still using old technologies and obsolete management systems. These plants do not even begin to meet the sustainability criteria that are becoming increasingly pressing, such as reducing energy costs and limiting environmental impact. At the same time, universities and other knowledge centres have sophisticated technologies in stock that would greatly contribute to a more environmentally sustainable sanitation. How do we bridge this gap?

One way in which BESSE set out to study knowledge brokerage processes was focused on hindering and facilitating factors: what stops the movement of knowledge and hinders learning, and what would facilitate the learning by overcoming such barriers to knowledge brokerage? The identification of these hindering and facilitating factors is an important finding of BESSE. However, our learning did not stop there.

This initial concept of knowledge brokerage and the search for hindering and facilitating factors seemed to presuppose knowledge as a static and packaged item, to be shipped from a knowledge centre to a knowledge user. While BESSE’s learning progressed, we modified this concept in two important ways. Firstly, knowledge is not static while being moved and distributed; it changes while its context changes. Secondly, knowledge brokerage is best conceived as a two-directional learning process and not as a one-directional distribution process. These two elements, in providing a more sophisticated understanding of knowledge brokerage, are documented below, especially in chapter 5. This more sophisticated understanding of knowledge brokerage is rooted in recognising the need for science and technology to be embedded in society; see an earlier EU-FP6 project on this ‘technological responsibility’: <http://www.techresp.eu/>.

2.4. BESSE: its process and structure

BESSE was conceived as a learning and knowledge brokerage process across several boundaries. The BESSE consortium comprised participants from three very different backgrounds: sanitation, public policy, and research. This could have been a dialogue of the deaf, but turned out to be very fruitful. This does not denigrate the misunderstandings, confusions, and frustrations that were inevitable when working across such borders; but when successful, the learning in such a heterogeneous group is much richer and deeper than in homogenous ones. Secondly, by having sanitation plants in Bulgaria, Italy and The Netherlands, BESSE could compare practices of sanitation in very different political, economic and technical locations. More work is needed to generalise our findings to a pan-European scale, but this breadth

of scope makes BESSE a good starting point for European policies pertaining to environmentally sustainable sanitation.

The BESSE project developed in three steps:

- (1) defining the problem and mapping the existing opportunities and challenges (this pertained to both knowledge brokerage and sustainable sanitation);
- (2) three pilot studies of knowledge brokerage in making sanitation more sustainable (in Bulgaria, Italy and The Netherlands); and
- (3) drawing lessons from these pilot studies about both knowledge brokerage and sustainable sanitation, and translating these lessons into policy guidelines.



3 BESSE Empirical Studies of Knowledge Brokerage in Environmentally Sustainable Sanitation

From its inception, BESSE was conceived as a project that had to be rooted in a broad empirical basis. In fact, it concerned an area – that of knowledge brokerage in sanitation – of which little or nothing was known. To do this, it was necessary to proceed step by step, differentiating the sources of information and using various methods of data collection.

3.1 Analysis of the state of the art

The first step was to analyse the state of the art sanitation systems and practices, especially of environmentally sustainable sanitation, and the use of knowledge brokerage in sanitation with the aim of establishing the current status quo and identifying potential advancements in the existing sanitation systems.

The following activities were carried out:

- a comprehensive **analysis of literature** pertaining to knowledge brokerage and ESS technology;
- an equally extensive **survey on the internet**, focusing especially on international sanitation stakeholders;
- **consultations** with 38 sanitation experts from 19 countries in Europe and beyond;
- **40 in-depth interviews** with sanitation experts and operators in Bulgaria, The Netherlands and Italy;
- **seven case studies** of innovative sanitation projects – two in Bulgaria, two in the Netherlands, two in Italy and one in Hungary (see box), mostly involving direct visits to projects and interviews with sanitation project managers.

Box: The seven case studies

- Modernisation and expansion of Sofia wastewater treatment plant ‘Kubratovo’, Sofia, Bulgaria
- Safe sanitation, health and dignity, implementation of dry urine diverting toilets and wastewater soil filters for schools and private households, Stara Zagora (10 villages), Pleven (two villages) and Sofia – Pravets municipality, Bulgaria
- The new Budapest central wastewater treatment plant – central and Eastern Europe’s largest environmental investment, Budapest, Hungary
- The constructed wetlands projects, Rome, Italy
- Mapping water supply and sanitation systems, Turin, Italy
- ‘Demon’ process, Water Board Veluwe, The Netherlands
- ‘Cannibal’ sludge reduction process, Zeewolde, The Netherlands

Using these different sources of information, **four steps of analysis** were carried out.

- The first step was to define **a map of available technologies** for environmentally sustainable sanitation, in all phases of the water treatment cycle. The technologies taken into account had to meet criteria for environmentally sustainable sanitation, for example saving energy, decentralising technologies, reducing environmental impact, and making design more modular and application more flexible.
- BESSE then produced **a map of the factors that hinder or facilitate** innovation in the field of sanitation, to understand the conditions under which knowledge brokerage could be used in sanitation. A review process analysed a series of knowledge brokerage practices oriented towards innovation. The map was validated and integrated by means of an on-line consultation process involving a number of experts in the knowledge transfer and sanitation fields.
- The **case studies** allowed us to carry out an empirical analysis, specifically aimed at studying the innovation processes in sanitation. Hence these case studies are not to be understood as best practices. Rather, they provided detailed information about what actually happens when an organisation (a utility, a research centre, a local government) tries to introduce innovative processes aimed at ESS. This enabled the BESSE researchers to identify new obstacles and enablers, and new practices aimed at innovation.
- The final step was to create an **international directory** (Wastewater Directory) of wastewater treatment stakeholders.

3.2 Pilot projects

After analysing the state of the art, the second phase involved experimentation. In fact, the only way to understand how, and under what conditions, knowledge brokerage could be used to speed up the innovation pace, was to conduct experiments focused on innovation in sanitation in different geographical areas and social contexts.

Three pilot projects were carried out: in Pernik (Bulgaria), Maastricht (The Netherlands) and Castel Sant'Angelo di Rieti (Italy). In the boxes below the three projects are briefly described. To facilitate comparisons, the three projects were carried out with a common methodology.

Box. Monitoring of the quantities and quality of industrial waste water discharged in the Pernik Municipality's sewerage system

Aim: increasing the connection rate of small-scale industrial enterprises to the municipal sewerage system via introduction of knowledge brokerage mechanisms.

Activities:

- 1) analysis of the current situation; identification and assessment of needs of Pernik Municipality concerning wastewater treatment;
- 2) identification of the main stakeholders involved in the handling of sanitation issues in Pernik Municipality;
- 3) mapping of resources available for connecting enterprises to the wastewater treatment system and for wastewater monitoring before discharging in Pernik municipality sewerage system;
- 4) identification of knowledge brokerage mechanisms that can be applied to improve the situation through consultation among the local actors;
- 5) carrying out of a workshop programme to train the local water supply and sanitation company inspectors on how to implement monitoring of wastewater discharged in the sewerage system and to implement effective control on this process;
- 6) organisation of a public presentation of the research findings and discussion on an Action Plan for implementation of the Programme for Monitoring of the Quantities and Quality of Industrial Wastewater Discharged in Pernik Municipality Sewerage System.

Box. Support to the Municipality of Castel Sant'Angelo di Rieti in the improvement of the existing sanitation system

Aim: activating processes of awareness raising about the role of sewerage in the sustainable management of the integrated water cycle, and enabling the creation of a sense-of-ownership of the local community toward the new collector which has been built using innovative materials to replace the previous one in order to accelerate impacts of innovation on the society

Activities:

- 1) integrated validation of the new technologies which were being introduced including
 - 1.1.) visits to the wastewater treatment plant;
 - 1.2) in depth interviews with different stakeholders;
 - 1.3.) collection of technical documents on the new collector technology;
 - 1.4.) definition of a validation programme;
 - 1.5.) design of training activities involving local technicians;
 - 1.6.) implementation of the validation programme;
 - 1.7.) development of a website for data and information sharing among the various actors involved;

- 2) programme of long-term monitoring activities, including
 - 2.1.) elicitation of the main information needs of the main actors concerning the data to be collected to assess the reliability of the sanitation system;
 - 2.2.) collection of the technical data concerning the network;
 - 2.3.) development of a first draft of the monitoring programme;
 - 2.4.) consensus achievement about the monitoring programme;
 - 2.5.) development of the final version of the monitoring programme;
- 3) development of a communication and dissemination plan addressing local actors, stakeholders and citizens, including:
 - 3.1.) creation of a website;
 - 3.2.) design of a public meeting aiming to raising awareness on the new sanitation system and environmentally sustainable sanitation;
 - 3.3.) information documents summarising the results of the conference and the information included in the website.

Box. Working towards sustainable sanitation in the Netherlands: the pilot project in Limburg

Aim: experimenting with knowledge brokerage activities to help Water Board of Limburg's (WBL) management and workers see the importance of moving beyond traditional design criteria of costs and effluent quality and incorporating sustainability in the general strategy of the WBL company.

Activities:

- 1) Organisation of an internal workshop aimed at facilitating a discussion about environmentally sustainable sanitation and related issues and at establishing the state of 'green thinking' within WBL;
- 2) selection of three focal points for further knowledge activities:
 - 2.1) the development of the idea of green thinking more generally;
 - 2.2) a model to evaluate sustainability in comparison to their design criteria;
 - 2.3) a communication plan to distribute the results of green thinking deeper into the WBL organisation;
- 3) analysis by documents and interviews on how sustainability is currently brokered within WBL;
- 4) development of a strategy map outlining the strategic goals of the organisation as a whole and the critical performance indicators to adopt;
- 5) organisation of an internal meeting to discuss the strategy map;
- 6) sending out of a questionnaire to external stakeholders to carry out a sustainability evaluation of the strategic map;
- 7) drafting of an internal memo on knowledge brokerage for the development of Modular Sustainable Water Sanitation Plants.

Each pilot project added to the empirical basis, providing first-hand information on:

- The factors that hindered or facilitated the use of knowledge brokerage in sanitation. These were then included in the final map.
- The role of knowledge brokerage in the implementation of actions to promote environmentally sustainable sanitation.
- The effective development of interactions between the different stakeholders involved in the processes of technological innovation in sanitation.
- The ways of dealing, in different contexts, with the purely technological and organisational issues involved in innovation (for instance scouting for new technologies, selection, adaptation, etc.).



4 Knowledge Brokerage and Innovation: towards a new understanding

4.1 A difficult path

In the initial phases of research, also on the basis of the international literature, the gap between new knowledge and its practical application was interpreted as merely the result of a **lack of communication**. It was assumed that the knowledge needed was already available and that the problem was mainly to make it known to practitioners. However, we soon realised that at least in the field of sanitation there is no readily available ‘supermarket of knowledge’. Furthermore, we observed that information on available technologies did not automatically orient users towards investing in technological innovation. The idea of explaining the technological gap in environmentally sustainable sanitation through the ‘supermarket’ model thus had, in short, to be abandoned.

We then decided to broaden the research in an attempt to identify which **factors of a non communicative nature** produced the biggest obstacles to relations between researchers and sanitation practitioners.

Knowledge brokerage performs several functions which go far beyond the mere transmission of information: it interprets users’ demand and provides information on different existing technological options; it promotes the creation of networks among sanitation stakeholders and practitioners so that knowledge can be shared easily and continuously; it may also organise practical demonstrations to help users understand how new knowledge or new technology can be practically applied.

However, even this approach failed to convince. Digging deeper by analysing the literature, interviewing industry experts and conducting case studies, we identified a far more extensive **range of obstacles to innovation in sanitation in Europe** than only relating to communication; a set of barriers that went well beyond the relations between the research community and the sanitation industry.

Serious widespread problems emerged in the way sanitation research is financed, designed and implemented, as well as in the attitudes of technology providers and utilities towards innovation. There were also obstacles related to sanitation policies, and especially to those geared towards innovation. And finally we found that technological innovation in sanitation is greatly influenced by cultural factors (such as stereotypes, representations, professional cultures).

This showed that knowledge brokerage should not just regard the transmission of knowledge from research to companies. Low levels of innovation in sanitation

in Europe are in fact closely tied to the attitudes of and relations between a **multiplicity of stakeholders** involved in all stages of innovation. These include utilities, which provide services; local governments, which in many cases own the infrastructures; national governments, which set framework laws and finance and direct research; supranational bodies, which establish regulations and standards; the European Union, both as one of the most relevant actors in the promotion of environmental policies and as a key research funding agency; and territorial organisations, civil society organisations and environmental organisations, which may raise issues about land use and environmental impacts.

4.2 Four forms of resistance to innovation

Using this broader perspective, which was strongly supported by the collected data, we established typologies for the wide range of obstacles and barriers that emerged during our research. This allows us to identify underlying processes. Thus, four general forms of resistance to innovation were identified:

- A. Technological inertia
- B. Community disengagement
- C. Institutional immobility
- D. Research weakness

A. *Technological inertia*

The greatest resistance faced by knowledge brokerage in sanitation is the **technological inertia** that characterises the sector, albeit to varying degrees in different national contexts. **Utilities** (including those managing large infrastructures) **seem to be less inclined towards innovation**: they are reluctant to adopt strategic approaches to innovation; they are unwilling to change organisational processes; they tend to be blind to the in-house knowledge they already possess; they are rarely able to handle all phases of the technology transfer process. This inertia reflects **a general culture of conservation**, also including plant construction companies and engineering consultancy firms (who strongly influence the sanitation technology market). Such a culture fosters the tendency to protect intellectual and technical capital from the risks of innovation, so as to maintain market positions without having to make new investments. Thus, companies providing technologies have **little interest in developing and disseminating new technologies**. There is little demand for innovation from utilities and they operate in a low-competitive business environment still strongly tied to the national context. All this result in business deeming it too risky to invest in innovative technologies.

B. *Community disengagement*

The technological inertia that characterises the sanitation field is maintained and fuelled by society's general disengagement from the issues pertaining to sanitation

sustainability. In fact, sanitation is not of great interest to many: it does not involve citizens or families; it does not often lead to the creation of civil society organisations, local associations or civic networks; it is almost never the subject of discussion between citizens and local governments; there is little coverage in the media. Added to this is the active and conscious opposition of certain professions such as doctors, engineers and farmers to some of the most basic criteria of sustainable sanitation. An additional factor in community disengagement is due to the **disharmonious relations among key players in the field of sanitation**. In fact, cultural stereotypes and preconceptions fuel, for example, suspicion about the role of private enterprise in the management of public utilities or doubts about the importance of scientific knowledge for utilities. Although this situation is by no means the same in all European countries, there is **no real social mobilisation over the issue of sustainable sanitation** in any EU country.

C. Institutional immobility

The lack of social mobilisation over sanitation issues contributes to a **substantial immobility among institutional, economic and cultural actors** involved in the governance of innovation in this field. Although there are great differences nationally, sustainable sanitation is **not high on the political agenda** even in countries where the political context is most favourable. Institutions and many sanitation stakeholders are unwilling to introduce innovations. This is because public policymakers and utilities are generally unable to grasp and interpret the social, technological and environmental realities of sanitation, and have, generally, little technical and scientific expertise. Thus, when innovation-oriented policies are introduced, they are weak and subject to frequent changes, revisions, interruptions and U-turns.

D. Weak research

A final major obstacle faced by knowledge brokerage is that **techno-scientific research in the field of sanitation is weak**. As emerged from the expert consultation carried out under BESSE, this weakness risks making research irrelevant to the issues involved because: little research is carried out; it is too academic; it fails to engage sanitation stakeholders; it does not respond to market needs. Research in this field also suffers from:

- **fragmentation**, since it is subject to disciplinary, institutional, communicative and regulatory barriers;
- **isolation** from global research trends;
- **self-referentiality**, because it gives little consideration to the needs of innovation.

In such a framework, even when alternative technological solutions based on ESS already exists, they rarely came into play. This weakness can be seen in all phases of techno-scientific research in sanitation—from the realisation of needs for new knowledge to the definition of new solutions to satisfy them.

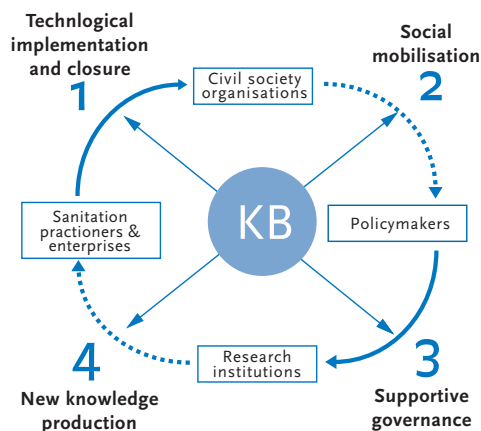
4.3 The innovation cycle

The four forms of resistance to innovation, combined, may result in a kind of **trap for ESS**. Indeed, the lack of community mobilisation over sanitation issues produces institutional immobility, which, in turn, leads to a lack of investment in research and innovation, fuelling technological inertia and reinforcing community disengagement from these issues. This results in what is paradoxically called ‘**conservative innovation**’¹. Innovation occurs and works but it is slow and produces no radical change. On the contrary, it tends to confirm and conserve the standard approach to sanitation. Such a process discourages investments in ESS-oriented technologies in a sector which, everywhere in Europe, already suffers from a lack of resources.

The discovery of this sort of ‘**vicious circle**’ has provided a better understanding of how the cycle of innovation in science and technology operates in sanitation: its different phases; the stakeholders involved in each phase; the role that knowledge brokerage can play in them.

On this basis, an **innovation cycle model** was developed, consisting of four processes:

1. **The process of technological implementation and closure**, which has the social goal of transforming new knowledge into technological innovation. This is when the results of research are used in the production of goods and services, with the development and application of technology that involves different players. The introduction of new technologies in everyday life impacts society in various ways, fostering the emergence of, for example, new lifestyles, values, ideas, sensibilities, etc.
2. The impacts produced by new technologies in the process of technological implementation and closure, as they spread through society, create new needs that



¹ T. P. Hughes, *Networks of Power*, Baltimore 1983.

gradually coalesce into demands for ‘something new’. This process activates different types of **social mobilisation** (for example, to bring new issues to the attention of the community, to propose new perspectives or new uses of technological solutions already in place, to set forth ideas or opinions represented by movements of different kinds, etc). When these forms of mobilisation begin to reach a critical mass, they come together and coalesce, creating social pressure for change.

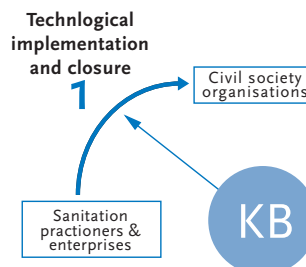
3. **Supportive governance** comes about when *social mobilisation* manages to engage institutional, economic and cultural stakeholders in supporting innovation. Gradually, the demand for innovation becomes more visible and substantial, attracting important players, such as enterprises, parties, governments, trade associations, the media, opinion leaders and so on. It is at this point that ESS enters the public agenda as an ‘issue’ of public interest, and specific governance mechanisms (such as regulations, research funding, policies) begin to take shape.

4. The last process of the innovation cycle is when *supportive governance* stimulates action from the research world to **produce new knowledge**, setting up new programmes, or new disciplinary or interdisciplinary areas. It is a process that obviously depends on the action of individual researchers or research groups, their passion, creativity, proactivity and skills in discovering or inventing something new. The production of new knowledge will then trigger, in a sort of upward spiral, a new process of technological implementation and closure.

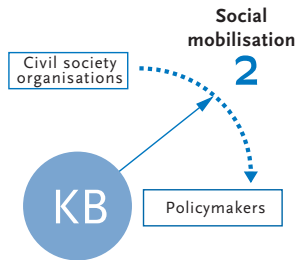
4.4 The multifaceted role of knowledge brokerage for more sustainable sanitation

The model described above allows us to recognise the different strategic values of knowledge brokerage in each of the four phases of the cycle. It may exert an action of mediation in different contexts and for different actors, and have a wide variety of roles and functions.

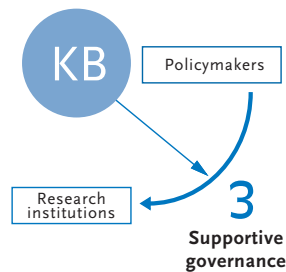
1. In process 1 (technological implementation and closure), the role of brokerage may be to **support changes in enterprises, construction companies and utilities**, raising awareness of the technical, economic and environmental advantages of greater innovation.



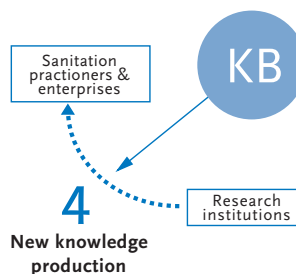
2. In process 2 (social mobilisation), brokerage could help increase public awareness of sanitation issues and civil society commitment towards environmentally sustainable sanitation. At this level, brokerage could also **act as a catalyst and an amplifier of new knowledge, and social** and environmental needs.



3. In process 3 (supportive governance), brokerage could **lobby political, economic and cultural institutions**. This would be done to ensure that institutions respond to the demands for sustainable sanitation present in society and support research in this field.



4. In process 4 (production of new knowledge), finally, brokerage may have the role of **fostering greater research relevance**, to produce a greater and faster impact on innovation through dialogue, meetings and discussions with beneficiaries and stakeholders.



4.5 From professional to strategic brokerage

In the above model, knowledge brokerage has a broader range of actions than normally ascribed to it. In fact, the standard image of knowledge brokerage is a tool to facilitate the transfer of existing scientific knowledge to contexts in which it can be practically applied – only phase 1 (technological implementation and closure) in our model. This model now highlights that brokerage can and should play an important role in the other processes (2, 3 and 4) too, expanding its scope to a broad range of actors and different types of knowledge, not necessarily merely scientific or technological.

Clearly, such wide-ranging and widespread actions cannot be left only to professional knowledge brokers. What is needed is **strategic brokerage**, to be implemented through appropriate public policies and through the commitment of major stakeholders, such as academia, citizens' associations and groups, and industry. This is the idea that the two following chapters seek to put into concrete form.



5 Lessons learnt

This chapter summarises the lessons learnt during the project about how **knowledge brokerage works in general**, leaving details concerning its role in the four processes of the innovation cycle for the policy guidelines to be presented in the next chapter.

It must be said that sanitation turned out to be a good testing ground for knowledge brokerage, since sanitation is highly **fragmented** in terms of knowledge, relations and even cultural and social representations. For this reason, some of the lessons learnt can be easily extended to other sectors and areas of application.

The lessons learnt are of three types, relating to the (i) understanding, (ii) setting up and (iii) application of knowledge brokerage in sanitation.

5.1 Understanding knowledge brokerage

- *Lesson Learnt 1*

- Knowledge brokerage is a widespread social process*

BESSE has shown that knowledge brokerage is not only the domain of professionals. It is a widespread and continuous social process, normally carried out – often without realising it – by people other than professional knowledge brokers such as researchers, utilities managers and operators, civil society representatives, local authorities and technology suppliers. This means that, before activating knowledge brokerage actions, we must understand how knowledge circulates and who carries out knowledge broker functions, so as to acknowledge and support these actors.

- *Lesson Learnt 2*

- Knowledge brokerage by itself is not sufficient for innovation to take place.*

The implementation of knowledge brokering actions is not enough to reverse the current trend of opposition to innovation in sanitation. As the project showed, the factors underlying the lack of innovation in sanitation are deep and widespread. It would be illusory and unrealistic to imagine that innovation can be achieved only through knowledge brokerage. Knowledge brokerage alone cannot, for example, solve the financial problems of sanitation research, change the behaviour of actors who are, at present, uninterested in innovation, or arouse widespread mass social mobilisation over sanitation issues where there is currently no activity.

- *Lesson Learnt 3*

- Knowledge brokerage is necessary for innovation.*

Knowledge brokerage is necessary for innovation. Without knowledge brokerage there is the risk that ‘things do not get going’. Knowledge brokerage can in fact produce a ‘chain reaction’ in the processes of change, forming a ‘critical mass’ in demands for change among different actors. This function is even more critical when tendencies for change are particularly weak, as in the case of sanitation.

5.2 Setting up knowledge brokerage

- *Lesson Learnt 4*

- Systemacity*

One of our major lessons was that investing in knowledge brokerage could not be done randomly, every now and again, or only in one area without thinking of the other areas connected to it. Knowledge brokerage has a better chance of success if it is part of a systematic effort. This process needs to take into account all aspects involved, which is continuous over time and which, as far as possible, follows a plan of action. For example, in the Limburg pilot project, to activate reflection on sustainable sanitation a comprehensive series of interventions were implemented within the local utility, and then progressively extended to other stakeholders. In Pernik, different strategies were used, for companies uninterested in connecting to sewage systems, to get them to discuss the problem.

- *Lesson Learnt 5*

- Integration*

Another lesson that emerged from BESSE was that knowledge brokerage works best when sanitation stakeholders are part of an integrated process, creating interaction and fostering negotiation. All pilot projects addressed the need to create new communication channels between stakeholders that previously had hardly any relations, often due to the lack of trust. For example, in Pernik technicians in the local utilities were wary of sanitation researchers and experts, while in Castel Sant’Angelo there was a similar problem in the relations between the local government and utilities. In both cases, our knowledge brokers had to set up new channels of communication to overcome this mistrust. A necessary step for initiating knowledge brokerage action was to find out who the stakeholders actually were, the relations between them, and the impediments to communication.

- *Lesson Learnt 6*

- Convergence of supply and demand*

Another aspect that emerged from the pilot projects was that those who seek new knowledge do not always know what knowledge they are actually looking for,

while those offering new knowledge do not know exactly for what and whom it will be useful. In Pernik, for example, the pilot project was initially mostly used to help different actors to formalise the knowledge (technical and regulatory) needed by stakeholders (companies, local administrators, technical experts) to connect companies to the wastewater treatment plants. Knowledge brokerage, in other words, works if it improves the quality of the demand for knowledge and the quality of the supply of knowledge; only then there can be convergence between demand and supply of knowledge.

- *Lesson Learnt 7*

- Adaptation at scale*

Another aspect that emerged from the pilot projects concerns the scale of knowledge brokerage interventions. There may be issues of knowledge brokerage on very different levels: within a single department, within an organisation, amongst different organisations, amongst whole sectors of society. However, we also observed that to resolve problems on one level, knowledge from other levels was needed too. In Pernik, for example, to address the problem of connecting businesses to wastewater treatment systems, the Ministry of Environment and Water had to be taken into account and it was necessary to cooperate with utilities in Sofia and Blagoevgrad to render actions in Pernik effective. In the case of WBL, it was important to consult national as well as local experts, and refer to the experiences of innovation in sanitation conducted in other areas of the country to promote the development of a sustainable sanitation strategy by the local utility.

- *Lesson Learnt 8*

- Reflexivity*

An important theme that emerged from BESSE is that knowledge brokerage works well if it can improve reflexive capacity in sanitation actors, i.e. a more open attitude towards the discussion of problems and an awareness of the importance of knowledge to solve them. In Castel Sant'Angelo, only after several meetings and knowledge brokerage initiatives, did the local government begin to seriously consider the problem of monitoring treatment plants. In the case of the Limburg pilot project, different activities were needed that aimed specifically at starting serious discussions within the utility on the sustainability of their sanitation procedures.

- *Lesson Learnt 9*

- Plurality of knowledge*

One lesson that emerged from the whole BESSE project was that any sanitation intervention requires different fields of knowledge and not only knowledge of scientific or technological nature. In the case of Pernik, in addition to technological knowledge, it was necessary to provide knowledge on national rules about the

disposal of industrial waste, on the local environmental situation, on companies' concerns about being connected to the treatment systems and on successful experiences elsewhere. In fact, what became clear is that scientific and technological knowledge is becoming increasingly dependent on other types of knowledge (procedural, organisational, social, regulatory, etc), without which the scientific knowledge is more or less useless. This means that different disciplines need to be involved, such as engineering, medicine, chemistry, biology, law, economics and social sciences.

5.3 Applying knowledge brokerage

- *Lesson Learnt 10*

Brokerage case studies

During BESSE case studies were successfully tested (WBL) to identify and capitalise on previous knowledge brokerage experiences in similar contexts. In these cases it was useful to identify the obstacles and enablers encountered by brokerage in previous experiences, so as to anticipate any problems in the new situation.

- *Lesson Learnt 11*

Brokerage survey

A useful tool to facilitate knowledge brokerage is to explore – through a series of preliminary meetings – the views of different stakeholders (Castel Sant'Angelo, Pernik) and ascertain whether they have positive or negative attitudes, what expectations they have, whether they use a collaborative or solitary approach, etc. In this way, it becomes easier to understand, for example, which tools seem most fitting to overcome opposition or what problems may arise when knowledge brokerage is started. Thus we may find out about the key players within the different organisations involved, especially those that can influence decision-making processes.

- *Lesson Learnt 12*

Preliminary analysis of knowledge needs

During BESSE the risk was noted that knowledge fails to satisfy the needs of different stakeholders. More effective action can be achieved by conducting a preliminary analysis of the cognitive needs of all stakeholders (WBL) by using different instruments (meetings, production and discussion of documents, in-depth interviews), so that knowledge needs may be determined in advance as accurately as possible.

- *Lesson Learnt 13*

- Participatory approach*

One lesson we learnt from the pilot projects, was that knowledge brokerage cannot be accomplished top down. The simple dissemination of knowledge does not work. A participatory approach is needed — one that facilitates the personal and emotional involvement of everyone. Knowledge-brokerage planning, too, is much more effective if implemented in a participatory manner (WBL). By planning, designing and acquiring new knowledge together, it is easier for stakeholders to establish ownership of the initiative, and to get involved in reducing opposition and obstacles. Moreover, participatory planning makes it easier to grasp the long-term impacts of brokerage, including those not initially foreseen and which often form the basis of strong opposition to innovation (for instance, the risk that the introduction of new technology produces a loss of jobs or a reorganisation of sanitation services that penalises some sectors to the advantage of others).

- *Lesson Learnt 14*

- Iterative interaction*

The pilot projects showed that it was impossible to transfer complex knowledge through single, individual meetings or initiatives. Knowledge brokerage can be promoted more effectively by planning iterative interaction at an early stage (for instance a series of meetings or tutorials) to give everyone time to get to grips with the problems, develop their own points of view, and absorb new knowledge.

- *Lesson Learnt 15*

- Plurality of perspectives*

Experimentation showed that brokerage can be improved by looking at problems and knowledge from different angles and perspectives (for example, those of management, technical staff, researchers, users, etc) (Castel Sant'Angelo). This gives target groups an overview of the issues and a better understanding of what is at stake.

- *Lesson Learnt 16*

- Flexibility*

In actions aimed at promoting knowledge brokerage, research found that different stakeholders may be more sensitive and respond better to some tools rather than others. Adopting a flexible approach that proceeds by trial and error seems to be the most effective method when the situation is one of opposition and conflicting interests such as that of brokering knowledge in sanitation. For this reason, it is best to make use of the many tools of knowledge brokerage (meetings, interviews, research activities, field trips, production and dissemination of documents, conferences, brainstorming sessions, etc.), choosing the ones that appear to be most suitable for the occasion.

- *Lesson Learnt 17*

- Transparency*

While carrying out different knowledge brokerage activities, it was seen that trust among stakeholders was a strong enabler. The approaches based on transparency and full information sharing among stakeholders were found to be the most effective tools for building cohesion around technology transfer.

- *Lesson Learnt 18*

- Visibility of the benefits of new knowledge*

Another element that proved decisive for the successful transfer of knowledge was to give as much visibility as possible to the benefits of acquiring new knowledge by means of brokerage. One of the most effective instruments was the organisation of demonstrations to give a ‘concrete’ form to the benefits of the new knowledge to be introduced. This effect can also be obtained through direct knowledge of experiences where new knowledge has been already introduced.

- *Lesson Learnt 19*

- Exploiting the local dimension*

In promoting knowledge brokerage, we saw how important it is to capitalise on the local dimension (Castel Sant’Angelo). This applies, above all, to locally acquired knowledge (for example, in utilities, in local universities, by local government technicians, etc). To this end, it may be particularly important to involve local sanitation experts, who are well acquainted with the problems of the area and who are already in contact with stakeholders interested in brokerage. Another good idea is to use, as far as possible, the same language, for example, in defining problems or in proposing possible solutions.

- *Lesson Learnt 20*

- Monitoring*

A powerful tool to promote knowledge brokerage was to involve stakeholders in periodic monitoring activities (Pernik). This highlights the actions already carried out and what remains to be done; secondly, it means that problems, opposition, conflicts or differences of opinion can be spotted and dealt with at an early stage.



6 Policy guidelines

6.1 Policy framework

This final section of the report is focused on how to shape **knowledge brokerage policies** to support environmentally sustainable sanitation in Europe.

As we showed in the previous sections, the context for innovation is unfavourable in the field of sanitation. The dominant orientation is towards ‘conservative innovation’ (see Chapter 4), for instance, a slow innovation process that stays within the path of traditional 19th-century sanitation. The **sustainability paradigm**, which is slowly entering energy production and urban solid waste management, is still hardly making way into sanitation.

Perhaps the **most significant** fact emerging from BESSE is that, to sort out this impasse, major sanitation actors have to develop their own **strategic knowledge brokerage** (see Chapter 4), understood as a coordinated set of actions and programmes (in short a policy) aimed at using knowledge brokerage to speed up the transfer and exchange of scientific, political, environmental, organisational or technological knowledge within the sector. This requires the creation or strengthening of all dialogue structures facilitating boundary work, whatever form they may take (innovation networks, roundtables, local observatory, participatory structures, etc.), as well as making knowledge transfer a **permanent habit** of sanitation actors and, therefore, a characteristic of their culture and a part of their operational standards.

A **second fact** highlighted by BESSE is that the lack of innovation in sanitation cannot be solved by only improving the interactions between research and industry, but mostly by ‘injecting’ knowledge brokerage in **all phases of the innovation process**. Strategic knowledge brokerage should therefore involve not only research institutions and utilities, but also the other major sanitation players, beginning with civil society organisations (especially environmental movements) and policymakers.

A **third fact** emerging from BESSE is that, at all stages of the innovation process, several **practitioners** (perhaps in smaller numbers than other sectors) are systematically performing **functions of knowledge brokerage**, as **professionals** or **civic activists**, although they are often not recognised – and then find it hard to recognise themselves as knowledge brokers. They can be found, for example, in the university liaison offices and science parks, science communication agencies, enterprise incubators, industrial districts, water utility networks, scientific and professional associations, water companies’ units, entities promoting media campaigns or engaged in social lobbying (for example, through rating or review activities) on environmental issues. We will operationally refer to them in these guidelines as ‘**KB practitioners**’.

Despite the presence of large overlaps between the **strategic knowledge brokerage** played by sanitation actors and the **practical knowledge brokerage** performed daily by KB practitioners, in these guidelines it may be useful to consider them as two distinct objects. They are viewed here as the **two souls of knowledge brokerage as a whole**; two souls to be integrated in order to achieve tangible results. Without a strategic perspective, in fact, KB practitioners may lose sight of the underlying objective to be pursued, namely to accelerate innovation in sanitation and direct it towards more sustainable technologies and procedures. On the other hand, strategic knowledge brokerage may encounter serious difficulties in turning ideas to facts without developing them in a practical dimension.

These guidelines focus attention on **strategic knowledge brokerage**. However, they will also present what emerged from BESSE to support practical knowledge brokerage in sanitation, keeping in mind that there is a broad tradition of practices and resources that KB practitioners – be they professionals or activists – can refer to.

The policy guidelines are therefore organised into **5 sections**. The first includes recommendations for the overall development of knowledge brokerage in sanitation, while the other four present recommendations respectively addressed to research institutions, utilities, civil society organisations (especially environmental movements) and decision makers. Of course, all recommendations are also addressed to the European Commission and the other European institutions. In the new perspective of Horizon 2020, these are destined to increasingly play a role in removing existing obstacles (related to, for instance, communication, professional cultures, policy strategies, interests and value), and in stimulating cooperation between key societal actors involved in research and innovation.

The recommendations are drawn from BESSE and, in particular, the map of the obstacles and facilitating factors for innovation in sanitation, the pilot projects, the inventory of innovative practices and the lessons learnt. At the end of each section there are some **methodological suggestions** aimed at KB practitioners, as they emerged from BESSE.

Each recommendation includes a title and **two parts**. In the first part ('the issue'), the contents of the recommendation are briefly described while the second ('actions') provides some examples (drawn from the BESSE experience) of activities that can be done to implement the recommendation.

6.2 Overall Recommendations

A first set of recommendations is designed to support the use of knowledge brokerage as a common practice in the field of sanitation.

- *R1. Putting knowledge transfer on the sanitation innovation policy agenda*

THE ISSUE. Most key players in sanitation are barely aware of the extent to which the delays in innovation stem from problems of identification, transfer and use of knowledge. A first step to be taken is, therefore, that of putting the issue of knowledge transfer on the agenda of such key players. Without improving knowledge transfer process overall, the aim of spreading more sustainable technologies in Europe remains impossible.

ACTIONS. Seminars on transferring knowledge to business associations, research institutions and civil society organisations, collection and study of best practices; development of information tools on knowledge transfer; development of dissemination tools.

- *R2. Promoting knowledge brokerage as a tool to support ESS*

THE ISSUE. Knowledge brokerage is not widespread in sanitation. Bringing out the relevance of knowledge transfer to encourage more sustainable sanitation does not automatically mean promoting the spread of knowledge brokerage. Key players in sanitation should therefore understand that knowledge transfer can not be achieved in the absence of a parallel spread of brokerage-related expertise, skills and professionals. Promoting knowledge brokerage should be a responsibility which primarily involves institutional actors, but also the national, European and International networks of local governments², sanitation professionals³, research institutions in the environmental field⁴, institutes engaged in environmental communication⁵ and environmental organisations⁶.

ACTIONS. Communication initiatives; awareness-raising campaigns; internet portals; scientific and political dialogue initiatives; development or reinforcement of networks involving knowledge brokers operating on environmental issues; dissemination of publications of a technical nature (toolkits, guidelines, handbooks) on knowledge brokerage.

- *R3. Attracting knowledge brokerage practitioners to the field of sanitation*

THE ISSUE. Knowledge brokerage is a professional field, which is still growing. There is an increasing awareness, among KB experts themselves, about the importance of

² For example, Eurocities, ICLEI-Local Governments for Sustainability, Association of Cities and Regions for Recycling and Sustainable Resource Management

³ For example, the International Water Association

⁴ For example, European Network of Environmental Research Organisations, EurAqua, Partnership for European Environmental Research

⁵ For example, the European Environment Information and Observation Network

⁶ For example, the European Environmental Bureau

applying knowledge brokerage, not only in areas where it is now most widely used (for example, that of medicine) and not merely for transferring knowledge from research to industry. There is therefore a favourable context to propose sanitation and, more generally, water cycle management as a privileged locus of professional commitment for knowledge brokers. This, however, requires a special effort, especially by the key players of national and international water and sanitation policies, to promote initiatives specifically geared to attract KB practitioners.

ACTIONS. Communication actions aimed at knowledge brokers' networks and institutes; involvement of experts in knowledge brokerage in activities (seminars, conferences, publications) focused on water and sanitation.

- *R4. Producing and accumulating experiences on the integration of KB practitioners with sanitation players*

THE ISSUE. To hasten the application of knowledge brokerage in sanitation, it is essential to promote a rapid accumulation of experiences based on the integration of KB practitioners and sanitation players. The goal is to show that integration can and must become a usual practice in sanitation.

ACTIONS. Dissemination of experiences already carried out; promotion of new integration initiatives (also in the form of pilot and demonstration projects); implementation of benchmarking initiatives aimed at transferring integration practice from other sectors; promoting research programmes of an experimental nature aimed at testing forms of structural change hinging on the integration of KB practitioners in research institutions, utilities and civil society organisations.

Box A. Some methodological suggestions for KB practitioners

From the methodological point of view, it may be particularly important for KB practitioners to use their mediation and communication skills to link up with other KB practitioners working on sanitation-related issues.

In this light, it would be useful to adopt a multifaceted and pluralistic vision of knowledge brokerage so as to include a broad spectrum of functions (communication, mediation, coordination and animation of networks, adaptation of knowledge to different contexts, science vulgarisation, etc). This should lead to mapping and the involvement of practitioners performing such functions, who almost always are not aware they are knowledge brokers.

BESSE also showed that those who perform brokerage functions do not have a clearly defined role. Sometimes, they act as the interface between their own organisation

(research institute, utility, technology company, civil society organisation, etc.) and other entities. Other times, however, they coordinate the management of knowledge within their own organisation and therefore are less visible from the outside. Many of them primarily operate through the internet while others carry out their mediatory role through personal contacts and face-to-face interactions. Therefore, to give visibility to knowledge brokerage activities already performed in sanitation it would be useful to adopt a pragmatic and inclusive approach.

Another suggestion that emerged from BESSE is to involve the direct beneficiaries of knowledge brokerage services, such as utilities that already interact with the universities through liaison offices, the technicians or technology companies that share information in professional networks, the policymakers who make use of experts in environmental issues or the local governments using information produced by civil society organisations on environmental problems in their territory. They can represent ‘testimonials’ of the importance of knowledge transfer but, above all, they can play an active role in developing knowledge brokerage policies within and outside of their organisation.

6.3 Recommendations for research institutions

A second set of recommendations addresses research institutions, public and private. For them, the knowledge brokerage priority is to increase the relevance of research results to application contexts in order to have more substantial and rapid impacts on the innovation processes in sanitation.

- *R5. Encouraging interaction among researchers, users and stakeholders at all stages of the research process in ESS*

THE ISSUE. One of the main features of what is called ‘post-academic research’⁷ is research that takes into account the potential contexts of use of the knowledge produced. Knowledge brokerage can greatly contribute to this process, encouraging close interactions between researchers, direct users of research results (technology development companies, utilities, etc) and stakeholders (such as civil society organisations) in all phases of the research process. Such interactions can also increase the quality of knowledge demand and supply, and further develop viable ESS-related strategies.

ACTIONS. Development of intermediate structures between research and business (science parks, university liaison office, etc.) specialised in sanitation; agreements

⁷ See, among the many authors dealing with ‘post-academic research’: Ziman, J. (2000) *Real Science. What it is and what it means*. Cambridge: Cambridge University Press; Nowotny, H. et al. (2001) *Re-Thinking Science - Knowledge and the Public in an Age of Uncertainty*. Cambridge: Polity Press

between utilities, technology developers, environmental organisations and research institutions for the creation of joint research teams, dialogue initiatives among universities, technology companies, utilities and civil society organisations on research programmes in sanitation; organisation of science days, conferences and seminars on sanitation issues.

- *R6. Enhancing communication on ESS-related research and its results*

THE ISSUE. Sanitation research is still facing major obstacles in benefiting from global trends in research, often remaining limited to the national dimension. This is partly because the technology market in this sector is still hardly globalised and highly dependent on national and local actors. Knowledge brokerage can provide an important support to bridge this gap by strengthening the access to and the circulation of high quality information on ESS-related research. This action is primarily directed at major sanitation actors, but also at the public at large. In this way, knowledge brokerage should also foster greater public attention on economic, environmental and social research programmes and encourage greater transparency in the activities of research institutions.

ACTIONS. Creation of databases, internet platforms, internet-based repositories and inventories on research programmes and technological options; development and circulation of documents summarising the scientific knowledge produced or in production, also through internet-based tools (news aggregators, websites, blogs); exhibition and fairs; dissemination activities through community outreach programmes; scientific communication activities (television, magazines, websites, events, etc) on sanitation.

- *R7. Promoting cooperation among disciplines and among different research areas connected to ESS*

THE ISSUE. The production of new knowledge in the field of sanitation is severely hampered by poor communication between scientific disciplines. In fact, sanitation is, by its nature, an interdisciplinary research field. However, a significant proportion of research in this area follows an academic approach that tends to reinforce disciplinary boundaries, which in turn foster institutional and communication barriers. A specific role of knowledge brokerage is then to remove, or at least lower, such barriers by creating bridges between the different stocks of knowledge, fostering interdisciplinary communication and promoting the emergence of common research protocols.

ACTIONS. Organisation of interdisciplinary research seminars; promotion and wider use of interdisciplinary journals, publications and websites focused on sanitation; identification and establishment of regular communication channels among

research teams working in different disciplines or in complementary research areas; cooperation agreements between scientific societies; organisation of courses, lectures and seminars focused on ESS involving different disciplines or research areas.

- *R8. Supporting the establishment and spread of new ESS-driven criteria for evaluating research programmes*

THE ISSUE. In the field of sanitation (and in other sectors too) research programmes are rarely evaluated according to their potential for innovation, their technological applications and their impact on environmental sustainability. Knowledge brokerage activities may be particularly useful to stimulate the inclusion of such criteria in research evaluation procedures; for example by facilitating the connection between funding agencies, research institutions and users of scientific knowledge (such as technology developers and water companies).

ACTIONS. Dialogue and consultation initiatives involving funding agencies, researchers and other stakeholders in the setting of funding programmes; inclusion of representatives of utilities and non-academic experts in the evaluation teams; gathering and dissemination of innovation-oriented evaluation practices; internet-based discussion spaces (forums, webzines, on-line conference and events) devoted to the issue.

- *R9. Encouraging university-industry partnerships to accelerate the transition from research to technological development and patenting*

THE ISSUE. One factor that may inhibit innovation in sanitation is the restrained attitude to patenting and the limited exploitation of the patents produced. This is due to various factors, many of which have been previously illustrated (inertia of utilities in innovation, poor development of the sanitation technology market, high costs of innovation, conservative culture of utilities, absence of a systemic approach to sanitation policies). Knowledge brokerage can help to get out of this impasse, facilitating the identification of knowledge that can lead to the production of new patents or the technological exploitation of existing ones, favouring a closer link between research teams, technology developers, funding agencies and utilities.

ACTIONS. Creation of specialised databases including unexploited patents in the field of sanitation; development of relations between research teams to encourage potentially patentable research; promotion of cooperation agreements and joint platforms involving research institutions; technology developers and utilities aimed at carrying out long-term experimental activities and developing patents; support the organisation of demonstration activities and demo-sites to obtain funding for the patenting of new technologies.

Box B. Some methodological suggestions for KB practitioners

Research institutions are, in general, very open to the exchange and transfer of knowledge. However, based on the BESSE outputs, it is possible to highlight some of the difficulties that KB practitioners who work with and for these institutions are likely to encounter and to suggest some possible solutions.

- As already stressed, organisational and disciplinary barriers within research institutions are very strong and structured. Knowledge brokers should therefore be sure to have the full support of management (deans, heads of departments, etc), so as to be entitled to freely interact with the research teams and get sufficient resources to carry out their work.
- Researchers tend to focus much attention on their own research. It is therefore essential that KB practitioners have technical expertise in ESS. This allows them to master the specialised scientific language and to understand and manage the technological implications of the research programmes they are dealing with. It is also important to encourage the use of brokerage tools requiring a limited amount of researchers' time (for example, avoiding meetings requiring the involvement of many people together and using internet-based communication tools as far as possible).
- For the same reason, researchers are inclined to give priority to relations with other researchers and to consider less useful interactions with other types of people. A goal of knowledge brokers is then to demonstrate to researchers that relationships with players external to the research community (policymakers, representatives of utilities, stakeholders, etc) may improve the quality of their own research (for example, helping them identify new research and increase the impact of their work). It may also be important – at least initially – to map and publicise brokering initiatives already implemented in the same institution or in other similar institutions so as to show their productivity in terms of research quality: Equally useful is to involve, from the beginning, researchers, research teams or departments that already show an interest or have experience in knowledge transfer.
- It should also be noted that there are strong cultural and language barriers hampering communication between researchers, utilities, civil society organisations and policymakers. KB practitioners should therefore avoid organising dialogue initiatives without planning a preparation path that can bring out expectations, motivations, strengths and interests of each player involved. It is of paramount importance that the first dialogue and cooperation initiatives are not disappointing and discouraging for the involved parties.

6.4 Recommendations for utilities and technology companies

With regards to water & sanitation utilities and technology companies (including plant construction companies and engineering consultancy firms), the primary role of knowledge brokerage may be to support them in activating cultural, organisational and communication changes so as to increase orientations to ESS.

- *R10. Making the economic and environmental benefits of ESS visible within the organisation and company networks*

THE ISSUE. Water & sanitation utilities have a low propensity to innovation, both because they operate on large infrastructures requiring big investments to be innovated and because they tend to keep their internal structures and technologies, also to ensure continuity of service. The ‘ideological basis’ for this is in a broader culture of conservation, which gives little value to new knowledge and leads to avoiding risks linked to innovation. To combat the conservative and risk-aversion approach usually shared by the water companies, knowledge brokerage can provide a contribution by making economic and environmental benefits of ESS technologies visible as well as by showing their compatibility with the service needs and finally their reliability and adaptability with a wide range of local contexts.

ACTIONS. Organisation of visits to technological sites; participation in demonstrations and showcases; undertaking of case studies on the application of ESS technologies; the dissemination of information on ESS in in-house communication facilities (newsletters, corporate intranet, internal communication circuits, etc).

- *R11. Promoting a multidimensional view of innovation*

THE ISSUE. Utilities and technology companies tend to underestimate the social dimension of sanitation, not to recognise the social, organisational and economic aspects of technology transfer and to give little importance, as pivotal aspects of innovation, to maintenance and management. Many utilities manage innovation activities in outsourcing, considering them peripheral to their strategic objectives. Consequently, the planning of innovation activities tends to be of low quality and short-term oriented. Knowledge brokerage can help them develop a multidimensional representation of innovation, support them to develop innovation plans embodying all the dimensions of innovation (including social, environmental and organisational aspects) as well as to exert more control over all stages of technology transfer (testing, installation, maintenance, etc).

ACTIONS. Negotiation activities on the organisation’s vision, mission and strategies; promotion of workshops, presentations, seminars and internal workshops; promotion

of advanced assessment tools on existing technological options which take into account environmental and social sustainability criteria.

- *R12. Facilitating a mainstreaming of innovation and ESS within water & sanitation companies*

THE ISSUE. Few sanitation utilities are organised for the effective management of innovation processes. In general, they show a lack of interest in reviewing their procedures; they usually adopt a top-down approach, often bureaucratic in nature; finally, the amount and quality of communication among their internal units are low. Even when they are willing to innovate, they often show limited ability to do so. Knowledge brokerage may act by promoting a mainstreaming of innovation within the company, bringing the issue of sustainable sanitation to all areas of the organisation, so as to enhance overall capacity to innovate.

ACTIONS. The development of quality management and monitoring tools; internal communication initiatives on innovation; creation of committees, specialised staffs and networks on innovation and ESS cross-cutting the organisation's structure; staff training; promotion of internal opinion pools, internal surveys and consultations on the organisation's innovation policies.

- *R13. Carrying out technology scouting*

THE ISSUE. Information on technologies and knowledge in the field of sanitation is scattered and fragmentary. This prevents an efficient evaluation of technological options and their adaptability to local conditions, from the environmental, technical, social and regulatory points of view. Knowledge brokerage can facilitate the realisation of technology scouting activities that help water companies identify solutions that best fit their technological, organisational and environmental needs.

ACTIONS. Collection of best practices; participation in fairs and exhibitions; promoting participatory platforms on technological scouting; demonstration activities; databases on ESS technologies.

- *R14. Dialogue with universities and research institutions*

THE ISSUE. One of the critical points – perhaps the most important – hindering innovation in sanitation is the reluctance of utilities to dialogue with research institutions. This is a problem, which, as we have seen (see Recommendation 5), appears to be the mirror image of a similar reluctance shown by researchers to interact with companies. Knowledge brokerage, in this context, is expected to

perform one of its typical functions, i.e. to establish communication channels enabling people who use scientific knowledge and technology to interact with those who produce it so as to facilitate the transfer of knowledge. The brokering of knowledge also helps manage all the obstacles and implications of that transfer regarding, for example, the mentality of the utility engineers and technicians, organisational routines, time organisation and communication within the company units concerned.

ACTIONS. Inclusion of academic researchers in laboratories and technical units managed by the company; cooperation with external research teams to identify and address the company's innovation needs, even in the medium and long term; promotion of informal relationships between utility experts and external researchers; development of cooperation programmes between utility networks, scientific institutes and/or individual research institutions.

- *R15. Taking stock of the knowledge already developed in the company*

THE ISSUE. Operating in a context dominated by a conservative approach, utilities and technology industries have mostly little control over the dynamics of knowledge within the organisation. Rarely do they apply knowledge management tools, so that often managers are not even aware of the knowledge that the organisation already has developed. One of the tasks of knowledge brokerage is therefore to seek out and take stock of the knowledge, skills and experience developed in the company so as to preserve them and to exploit them for innovation.

ACTIONS. Scouting activities within the organisation through: interviews with 'gatekeepers' of the various units; creation of centralised repositories or collections of documents, materials and projects; networking activities involving the staff; rapid access (e.g. through intranet) of ready-made information on internal knowledge and know-how; adoption of reporting standards facilitating the access of technical information.

- *R16. Fostering the development of local, national and international innovation networks in sanitation*

THE ISSUE. The many factors hindering innovation in sanitation (see chapter, 4) make it difficult, for a single company, to shift from the traditional sanitation paradigm to the ESS paradigm. Such a shift can hardly be triggered if each water company works in isolation, without activating forms of cooperation, coordination and exchange with other sanitation players. Knowledge brokerage can facilitate this transition, supporting the development of local, national and international sanitation networks and widening the participation of existing ones. This type of policy provides ESS with a context of legitimacy and can trigger wider processes of knowledge transfer with a focus on innovation.

ACTIONS. Activities for exchanging experiences among water companies; twinning initiatives; promotion and support of virtual networks, support for water company associations and networks, development and dissemination of documents and handouts on ESS for water utilities and technology companies.

Box C. Some Methodological suggestions for KB practitioners

BESSE research and experimentation activities have produced suggestions for KB practitioners working within or in contact with water & sanitation companies.

It should first be said that in utilities, being organisations, little can be done without the full commitment of management.

It is therefore important that:

- links between brokerage activities and the company's mission and strategies are clear;
- management commitment in knowledge brokering is visible, so that staff can perceive that it is the management that drives the process;
- KB practitioners, if they come from outside the organisation, are able to use language, terms and expressions which are familiar to the staff and have the technical skills necessary to interact with management and technical staff.

To facilitate brokerage, it is also methodologically important to use as far as possible internal expertise. It is equally important to collect information about how innovation is managed in the utility, so as to identify, for example, resistance to knowledge sharing, good practices and the expectations of staff members of knowledge brokerage.

Developing a sense of ownership in the staff of the brokerage process is also of pivotal importance. To this end, KB practitioners should prevalently use knowledge brokerage tools facilitating participation and co-development.

Finally, the pilot projects carried out under BESSE show the importance for KB practitioners to support the utility from the beginning in planning their strategic knowledge brokerage activities. When KB practitioners are external consultants, it must be understood by staff and management that they are only facilitators and that the utility should soon be able to fend for itself and to autonomously manage knowledge transfer processes using internal staff.

6.5 Recommendations for civil society organisations

Another set of recommendations target civil society organisations. The overall role knowledge brokerage can play here is that of catalyst and amplifier of social

and environmental needs and demands, helping such organisations promote social mobilisation in support of more sustainable sanitation approaches.

- *R17. Raising awareness of the risks of conventional sanitation*

THE ISSUE. It is a widespread belief that traditional sanitation systems have definitively solved the problem of liquid waste management, without damage or risk to the environment or people. In the public view, sanitation is not connected with health and environmental issues. There is also a lot of cultural resistance to making the management of human excreta a subject of public debate. In this framework, knowledge brokerage may provide key support in raising the awareness of civil society organisations and the public at large about the deep links between wastewater management and other major environmental issues (water supply, sustainable agriculture, land protection, energy saving, etc.) as well as showing the risks of conventional sanitation.

ACTIONS. Educational and demonstration activities in the schools; public information campaigns; development and distribution of information packages (reports, videos, etc.) on sustainable sanitation; organisation of opinion polls aimed at collecting data on people's attitudes on sanitation-related issues; development of Internet sites on topics related to water cycle management; awareness raising activities on ESS targeting journalists and media practitioners.

- *R18. Promoting alliances and networks in support of ESS*

THE ISSUE. Collective disengagement from sanitation issues prevents the formation of 'social pressure' to urge policymakers to promote more sustainable forms of wastewater management. Knowledge brokerage can oppose this process by bringing together individuals and organisations with a greater propensity for this issue, promoting alliances and local or national networks involving different sectors of civil society, professional networks, scientific societies, local authorities or public utilities. When appropriate, these alliances and networks may have a technical-scientific nature or they may pursue the more general aim of raising awareness in citizens and public opinion of sustainability in sanitation.

ACTIONS. Promotion of internet portals as a way of creating informal networks on sustainable sanitation; organisation of local, national and international meetings; promotion of networks for the spread of specific ESS inspired technologies; activation of web forums; organisation of events or thematic panels on sanitation.

- *R19. Attracting key professional groups (doctors, engineers, agronomists, technicians) to ESS*

THE ISSUE. In a context already very unfavourable for promoting social mobilisation over sanitation, the presence of strong opposition from some key professional groups (medical doctors, agronomists, hydraulic engineers, sanitation technicians themselves) to some basic criteria of sustainable sanitation (for example, wastewater recycling or the decentralisation of sanitation systems) is also to be recorded. In the absence of a public debate on sanitation issues, this opposition has no difficulty in hindering the spread of technologies promoting sustainable sanitation approaches. In that case, knowledge brokerage can help spread evidence-based knowledge on ESS among such professional groups in an attempt to change their cultural orientations and views on sustainable sanitation.

ACTIONS. Specific training sessions tailored to the information needs of specific professional groups; visits to sites where ESS technologies have been successfully applied; exchange meetings between different professional groups involved in sanitation systems and policies; dialogue initiatives on sanitation within professional associations, societies and networks; dissemination of information on ESS through magazines, newsletters and other communication channels used by professional networks; promotion of professional training courses and learning initiatives to enrich professional curricula with expertise and skills related to sustainable sanitation.

- *R20. Making ESS-oriented technologies visible*

THE ISSUE. The majority of people, as well as many sanitation practitioners and stakeholders, are unaware that sanitation problems can be addressed through approaches radically different from conventional ones. Besides that, there is also much scepticism among many sanitation actors about the effectiveness of ESS-oriented technologies. To promote ESS, therefore, it is of strategic importance to show that ESS-oriented technologies exist and are effective. Knowledge brokerage may have an important role in this domain, facilitating the implementation of programmes and initiatives addressing sanitation practitioners, local stakeholders, local authorities and the population at large to show how such technologies work and how and under which conditions they can be applied.

ACTIONS. Visits to sites and plants where ESS technologies have been applied; organisation of exhibits on innovative technologies in the field of sanitation; media campaigns; audio and video products on ESS-oriented technologies.

- *R21. Opening communication channels between citizens and sanitation players on innovation*

THE ISSUE. In some areas (for example, water supply, energy, health, solid waste management), procedures and mechanisms for dialogue between citizens and service providers have been gradually established, even though often they did not succeed in preventing conflicts and tensions. Despite this, dialogue can achieve higher levels of quality, participation and transparency in the management of public services. In the field of sanitation this process has not yet occurred, if not in episodic forms. Knowledge brokerage can greatly help bridge this gap, fostering the establishment of new communication channels between citizens and sanitation service providers to promote a real debate on future choices and investments in innovation.

ACTIONS. The promotion of participatory budgets and environmental budgets for utilities; participatory evaluation activities of sanitation services involving citizens and citizens' organisations; dissemination of scientific and technical information; internet-based two-way communication activities; organisation of public hearings on wastewater management at local level; technological forecasting exercises focusing on water cycle management.

Box D. Some methodological suggestions for KB practitioners

From the results of BESSE, some key points can be singled out on which KB practitioners should focus their attention.

Firstly, while working within the civil society, KB practitioners should help sanitation actors develop their capacity to inform citizens on sanitation issues. Although the technical expertise of KB practitioners remains important, what makes a difference is their ability to communicate simply and effectively with a wide and fragmented audience on issues having also technical contents.

In this respect, at least three suggestions can be made:

- leveraging on the existing opportunities for environmental communication at the local or national level, be they initiatives (campaigns, events, etc.), communication means (newspapers, television programs, blogs, websites, etc.), players (environmental groups, independent experts, etc.) and resources (funding, skills and expertise, etc.);
- helping civil society organisations that are more sensitive to sanitation form a coalition aimed at developing strategic knowledge brokerage programmes on sanitation addressing the public at large;
- promoting knowledge brokerage actions starting from the local dimension (which people tend to perceive more) showing how sanitation is managed locally

and the existence of possible more sustainable alternatives that are taking place elsewhere, thus creating a bridge between the local and the global.

Regarding the involvement of civil society, a further suggestion for KB practitioners that emerged from BESSE is to use a broad and inclusive concept of civil society. Knowledge brokerage, in fact, should not only focus on environmental organisations. There are many civil society actors who may be involved in brokerage activities such as professional networks, service-sector enterprises, agricultural enterprises, cultural groups, grass-roots groups, groups working in fields other than the environment (health, education, poverty and social exclusion, transport, elderly, cultural heritage, etc.).

6.6 Recommendations for policymakers

The last set of recommendations concern policymakers. The social function held by knowledge brokerage may be to facilitate lobbying activities addressed to those political, economic and cultural institutions that play a role in decision-making processes related to sanitation and sanitation research, in order to increase their engagement in support of more sustainable approaches to sanitation.

- *R22. Including sanitation in the agenda of environmental policies*

THE ISSUE. Sanitation in general and, by extension, research in this area, is not a political priority. Most of the funds on environmental sustainability are channelled to other issues such as energy, solid waste management or biodiversity protection. This fact stems, in part, from the lack of interest of policymakers and often water company managers in seeing and understanding the environmental and economic risks associated with conventional sanitation and in recognising the added value produced by sanitation approaches based on sustainability and recycling of excreta and urine. A role that knowledge brokerage can play in order to counter the inertia of institutional actors is that of fostering the inclusion of sanitation issues in the agenda of environmental policies, thus promoting change in the political culture.

ACTIONS. Involvement of decision makers in public seminars and initiatives on sanitation; production and dissemination of publications, toolkits, guidelines and sourcebooks on sustainable sanitation in relation to other environmental issues specifically conceived to be read by policymakers; production of policy briefs and policy papers on ESS; awareness raising programmes addressing local authorities; collection and dissemination among policymakers of information and statistical data on risks related to traditional sanitation systems and on benefits deriving from ESS-oriented technologies.

- *R23. Facilitating regular interaction between expert knowledge and decision making on ESS*

THE ISSUE. In addition to the problem of a lack of awareness on sanitation needs, often policymakers and their staff suffer from a lack of technical and scientific support, due to poor interaction with experts and researchers. This reduces their ability to understand what is at stake with the shift from traditional to more sustainable sanitation technologies as well as the elements of complexity inherent in sustainable sanitation, be they related to environmental dynamics (water cycle, nitrogen cycle, etc.) or the social and organisational aspects. An important contribution knowledge brokerage may provide is facilitating regular interaction between policy making and expert knowledge on ESS to enhance the quality of the decision-making processes in this field.

ACTIONS. Involvement of experts on ESS in the places where environmental policies are planned (parliamentary committees, task forces for the development of public environmental policies, etc.); organisation of seminars for decision makers and their staff; promoting flagship initiatives and best practices in interaction between policymakers and experts; establishing virtual information desks tailored to policymakers' information needs about environmental issues.

- *R24. Coordination of the different institutional levels involved in sanitation policies*

THE ISSUE. Several problems related to innovation in sanitation stem from the fact that such a sector is managed by many public and private actors operating at different levels with varying degrees of responsibility. Interaction between these actors tends to be, for various reasons, not very efficient. Moreover, they often have diverging interests and points of view and are rarely able to establish forms of collaboration effective enough to adequately support research and innovation. The role of knowledge brokerage should be particularly useful in promoting an alignment and coordination among such actors to foster convergence on ESS-oriented policies.

ACTIONS. Promotion of formal and informal contacts among the players involved; activation of institutional arrangements allowing rapid contacts and simplified coordination procedures; institutional networking activities; promotion of consultation meetings and joint initiatives; development of monitoring activities on the implementation of public policies on water & sanitation and dissemination of the results to the ministries and administrations concerned.

- *R25. Facilitating the production of regulations and standards to support research and innovation in sanitation*

THE ISSUE. The sanitation sector is characterised by regulations and standards that are largely insufficient for the development of innovation processes. In general, and apart from some EU member states, regulations often penalise the adoption of new technological solutions and impose standards that are too rigid. Moreover, regulations and standards often change over time and lend themselves to different interpretations. These characteristics hinder scientific and technological research, discourage investors from funding new research programmes and, more generally, create pessimism about being able to develop innovative solutions. In this framework, knowledge brokerage help by facilitating the dissemination of knowledge on existing rules and regulations to highlight the barriers and bottlenecks to innovation they produce, even unintentionally, and to accelerate the development of regulations encouraging innovation and the production of new patents in the field of sanitation.

ACTIONS. Research and collection of data on regulations on sanitation for dissemination (through publications, online databases, electronic publications, etc.); consultation and opinion pools among sanitation players on regulations and standards in order to identify barriers to innovation and to collect proposals for change; collection of best practices in standard setting; promotion of the development and application of innovation-oriented policy evaluation criteria.

- *R26. Supporting the creation of a critical mass of actors that can mobilise resources for ESS-oriented research*

THE ISSUE. Some countries and agencies are developing practices specifically designed to complement traditional forms of research funding with additional mechanisms to give research more stability and continuity. These mechanisms are aimed, inter alia, to compensate for the low profitability of innovation in the sanitation market; support enterprises and research institutions in dealing with the typically lengthy procedures necessary to develop and test new technologies; encourage the involvement of a plurality of stakeholders (such as utilities, technology manufacturers and national governments) in research funding. Knowledge brokerage can play a key role in facilitating the establishment of a critical mass of actors that can potentially mobilise resources for research on ESS by transferring knowledge about new funding mechanisms and new practices, optimising the use of research funds.

ACTIONS. Creation of information platforms facilitating the establishment of agreements on water and sanitation research and the coordination of different funding agencies and programmes; transferring knowledge on possible

institutional arrangements encouraging the creation of public-private research funds; establishment or enhancement of networks involving research funding agencies and institutions (venture capital, credit institutions, etc.); information campaigns to raise funds for research on ESS; support for establishing incubators and high-tech spin-offs focused on ESS-oriented technologies; awareness raising activities addressed to water companies to encourage engagement as research funders or promoters.

Box E. Some methodological suggestions for KB practitioners

Regarding decision makers, KB practitioners can be of great support, even using the traditional tools and approaches of social advocacy and lobbying. In this regard, we can single out some methodological suggestions, which, in light of the experience of BESSE, seem particularly relevant.

- Communicating with policymakers requires from KB practitioners a great capacity to reframe knowledge on ESS from the perspective of the decision making process. This primarily involves developing the knowledge transfer process in a way that highlights the issues to which policymakers are most sensitive, such as benefits, risks, costs, times, regulatory constraints, funding sources, alternative options, litigation, citizens' opinions, successful experiences, economic impacts or opportunities for patenting. This contribution of KB practitioners can be of great support to sanitation actors to help them develop strategic knowledge brokerage plans addressing policymakers, aiming not only to inform and sensitise them on ESS but also to provide them with specific proposals of feasible measures to take.
- KB practitioners may also provide a major contribution in identifying the key players, namely the political actors who have most power to influence decisions on sanitation and to whom knowledge brokerage activities are mainly to be addressed. Therefore KB practitioners should be acquainted with decision-making processes, regulations and regulatory constraints in the sanitation sector and know how political and regulatory institutions work and interact.
- The policy decisions are (or should be) based as far as possible on evidence-based knowledge and information. This often comes up against the uncertainty that characterises scientific research. One of the main tasks KB practitioners should be able to perform is therefore to select the scientific and technological knowledge to be transferred in order to give precedence to information and data based on evidence and to communicate and contextualise it in a way that allows policymakers to absorb them.
- Another kind of knowledge that knowledge brokerage should be able to transfer to policymakers concerns the social demands on sanitation. To help

achieve this goal, KB practitioners should develop certain specific communication skills, similar to those typical of investigative journalism: narrative skills, skills in the use of iconographic language; ability to ‘dramatise’ critical situations in order to make them more understandable, visual use of statistics, etc.

6.7 The future mission of knowledge brokerage in sanitation

The recommendations presented above highlight the perspective adopted in this report to understand the future mission of knowledge brokerage in sanitation. Overall, two main policy drivers emerge from BESSE. On the one side, key sanitation actors are invited to take knowledge brokerage seriously, so seriously that they should place it strategically at the very centre of their policies. On the other side, because of the same mechanisms of knowledge brokerage, other stakeholders should be taken seriously too. This means accurately identifying needs, attitudes and orientations of the involved actors before devising knowledge brokerage strategies and selecting the most appropriate approaches and tools.

During the implementation of BESSE, knowledge transfer proved to be a key factor for the spread of ESS-oriented policies, even though there are other factors that come into play, such as the levels of investments for the construction of more sustainable sanitation infrastructures and the availability of funds to support innovative research programmes in this field.

However, to fully perform its task, knowledge brokerage must have a much clearer and more visible role than it has today. The extent to which it can facilitate innovation is linked to its capacity to be a catalyst of social energies, actors, resources and ideas, fostering the achievement of concrete and widespread results in as short a time as possible. This is particularly true in the case of sanitation, where innovation processes are hindered by different factors. However, it is also relevant for many other sectors, be they related to environment or not, where interactions and cooperation among the key players are similarly difficult.

Precisely for this reason, knowledge brokerage has to become a practice that is commonly applied in all phases of innovation and shared by all actors involved in the innovation process. Moreover, knowledge brokerage must be able to adapt to different environmental conditions, specific organisations, and varying local and national contexts. It must never lose sight of the need to be concrete and to pursue concrete results. Changes in the societal perception of sanitation would also be part of such concrete results.

These guidelines, concerning the idea of strategic knowledge brokerage, refer to a coordinated set of knowledge brokerage actions that have a strategic value for the promotion of sustainable sanitation in which key sanitation players, starting with those most sensitive to the issue of sustainability, should increasingly invest in the future. These guidelines thus concur with the European Commission’s efforts to

mobilise environmental knowledge for policy, industry and society.

Besides this, a second message emerged from BESSE. In order for this perspective to materialise, it is also necessary to improve the quality and visibility of what has been previously referred to as practical knowledge brokerage. Reference is made here to knowledge brokerage as a daily practice, usually deemed to be marginal and of little weight, while it requires highly qualified professional skills and know-how, regardless of whether it is performed on a paid or voluntary base.

As we have seen, it is not always easy to distinguish strategic knowledge brokerage from practical knowledge brokerage. However, distinguishing between them is useful, at least to understand how important it is to increase the use and quality of knowledge brokerage in its practical dimension in order to devise effective strategic knowledge brokerage plans.

Policy guidelines

Recommendations, overall

R1. Putting knowledge transfer on the sanitation innovation policy agenda

R2. Promoting knowledge brokerage as a tool to support ESS

R3. Attracting knowledge brokerage practitioners to the field of sanitation

R4. Producing and accumulating experiences on the integration of KB practitioners with sanitation players

Recommendations for research institutions

- R5. Encouraging interaction among researchers, users and stakeholders at all stages of the research process in ESS
- R6. Enhancing communication on ESS-related research and its results
- R7. Promoting cooperation among disciplines and among different research areas connected to ESS
- R8. Supporting the establishment and spread of new ESS-driven criteria for evaluating research programmes
- R9. Encouraging university-industry partnerships to accelerate the transition from research to technological development and patenting

Recommendations for utilities and technology companies

- R10. Making the economic and environmental benefits of ESS visible within the organisation and company networks
- R11. Promoting a multidimensional view of innovation
- R12. Facilitating a mainstreaming of innovation and ESS within water & sanitation companies
- R13. Carrying out technology scouting
- R14. Dialogue with universities and research institutions
- R15. Taking stock of the knowledge already developed in the company
- R16. Fostering the development of local, national and international innovation networks in sanitation

Recommendations for civil society organisations

- R17. Raising awareness of the risks of conventional sanitation
- R18. Promoting alliances and networks in support of ESS
- R19. Attracting key professional groups (doctors, engineers, agronomists, technicians) to ESS
- R20. Making ESS-oriented technologies visible
- R21. Opening communication channels between citizens and sanitation players on innovation

Recommendations for policymakers

- R22. Including sanitation in the agenda of environmental policies
- R23. Facilitating regular interaction between expert knowledge and decision making on ESS
- R24. Coordination of the different institutional levels involved in sanitation policies
- R25. Facilitating the production of regulations and standards to support research and innovation in sanitation
- R26. Supporting the creation of a critical mass of actors that can mobilise resources for ESS-oriented research



